

Search for di-Higgs resonances decaying to 4 bottom quarks at the LHC

(The CMS Collaboration)

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A search for a model-independent, narrow decay-width, di-Higgs resonance where both Higgs decay into bottom quarks is performed with 17.9 fb^{-1} of p-p collision data acquired at $\sqrt{s} = 8 \text{ TeV}$ by the CMS experiment at the LHC. Upper limits on the production cross sections times branching fractions for such a resonance, with masses between 270 GeV and 1100 GeV, are presented.

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Following the discovery of the Higgs boson at 125.6 GeV [1, 2], it has become experimentally important to search for any pair production mechanism for it. Resonant pair production of the Higgs is posited by some hypotheses beyond the Standard Model, such as Randall Sundrum (RS) extra dimensions [3–5], and the Next-to-Minimally Supersymmetric Standard Model [6]. In RS models, a scalar bulk field used to stabilize the radius of the warped extra dimension gives rise to a particle at the electroweak scale, the radion, which can decay to a pair of Higgs with a narrow width. This Letter presents an extensive search for such di-Higgs resonances between masses of 270 GeV and 1100 GeV where both Higgs decay into bottom quarks. We perform this search with 17.9 fb^{-1} of proton-proton collision data acquired at $\sqrt{s} = 8 \text{ TeV}$ by the Compact Muon Solenoid (CMS) detector at the Large Hadron Collider (LHC). The central challenge of this search is to distinguish the signature of four bottom quarks in the final state, that hadronize into jets, from the immense multi-jet chromodynamic background in p-p collisions. This is addressed by powerful b-jet identification techniques at CMS and a data-driven estimation of the background.

The central feature of the CMS apparatus is a superconducting solenoid of 6 m internal diameter, providing a magnetic field of 3.8 T. Within the solenoid volume are a silicon pixel and strip tracker, a lead tungstate crystal electromagnetic calorimeter, and a brass and scintillator hadron calorimeter. Muons are measured in gas-

ionization detectors embedded in a steel flux return yoke outside the solenoid. The tracker provides an impact parameter resolution for charged tracks of $\approx 15 \mu\text{m}$, and this is critical for reconstructing secondary vertices of jets for b-jet identification. The first level of the CMS trigger system, consisting of custom hardware processors, uses information from the calorimeters to select the events for this analysis. The second level of the CMS trigger, consisting of generic PC processor farms, further selects events using information from the calorimeters and trackers before sending them downstream for detailed processing and storage. A more detailed description of the CMS detector can be found elsewhere [7].

Analysis Strategy. The interpolation of background shape. Discuss the separation into two regimes.

Data used and trigger.

Physics Objects. Jets and b-tagging.

Event Selection. For High Mass and Low Mass Regimes.

Signal Generation and Modeling.

Background Prediction.

Systematic Uncertainties. Table here.

Result. Expected Limits.

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